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AN EXPERIMENT IN TEACHING A SECOND LANGUAGE. REV. OF APPLIED LINGUISTICS IN LANG. TEACHING, 4(2)/85-113, JUNE 1966).

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AN EXPERIMENT AT GEORGETOWN UNIVERSITY WITH EIGHT COLLEGE FRESHMEN INVOLVED A SEMIAUTOMATIC METHOD OF TEACHING A RAPID INTRODUCTION TO THE BASIC STRUCTURE OF GERMAN DERIVED FROM AN OPERANT CONDITIONING ANALYSIS OF VERBAL BEHAVIOR. THE PREDOMINANT FEATURE OF THE PROGRAM WAS A MATCHING-TO-SAMPLE TECHNIQUE UTILIZING A TEACHING MACHINE AND CARDS. THE MAJOR PROGRAMING PRINCIPLE WAS TO DIFFERENTIALLY REINFORCE THE STUDENTS BEHAVIOR AS HE WAS PRESENTED WITH SIMPLE OR MIXED TEXTUAL, PICTORIAL, AND AUDITORY STIMULI. REINFORCEMENT OCCURRED IN THE FORM OF IMMEDIATE FEEDBACK INDICATING THE CORRECTNESS OF THE RESPONSE. THE HYPOTHESIS OF THE EXPERIMENT WAS THAT AN EXTENSIVE REPERTOIRE AS A LISTENER AND READER WOULD PROVIDE THE BASIC PERFORMANCE FROM WHICH SPEAKING AND WRITING COULD EMERGE. IT WAS ASSUMED THAT THE STUDENT WOULD REINFORCE AND SHAPE HIS OWN BEHAVIOR AS HE HEARD DIFFERENCES BETWEEN HIS OWN SPEECH AND THAT OF THE NATIVE MODEL. ANOTHER FEATURE OF THIS LARGELY AUTODIDACTIC PROGRAM WAS THE BRIEF TEST GIVEN THE STUDENT AFTER EACH LESSON WHICH MEASURED HIS TOTAL PERFORMANCE TO DATE. ALTHOUGH THE RESULTS OF THE EXPERIMENT SUPPORTED THE HYPOTHESIS THAT SPEAKING AND WRITING SKILLS CAN BE TAUGHT THROUGH AUDITORY AND TEXTUAL MATERIALS, THAT PROCEDURE WAS NOT RECOMMENDED AS THE SOLE TEACHING METHOD. THE DOCUMENT INCLUDES AN EXTENSIVE, DETAILED DESCRIPTION OF THE DESIGN, METHODS, TECHNIQUES, PHASES, AND RESULTS OF THE EXPERIMENT. THIS ARTICLE IS A REPRINT FROM "INTERNATIONAL REVIEW OF APPLIED LINGUISTICS IN LANGUAGE TEACHING," VOLUME 4, NUMBER 2, 1966. (AUTHOR/AS)

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AN EXPERIMENT IN TEACHING A SECOND LANGUAGE

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AN EXPERIMENT IN TEACHING A SECOND LANGUAGE[1,2])

M. I. Rocha e Silva and C. B. Ferster[3])

Dans cet article on décrit une méthode partiellement automatique pour enseigner rapidement à des éléves les notions de base de la structure grammaticale de l'Allemand. La méthode est dérivée d'une analyse du comportement verbal selon la théorie du conditionnement opérant et comporte surtout "l'appariement à l'échantillon" (*matching to sample*). Le programme utilise une machine à enseigner qui présente des stimuli textuels, graphiques ou auditifs, simples ou mélangés, à l'élève et l'oblige à choisir parmi plusieurs réponses textuelles ou graphiques. En suivant ce programme, l'élève agit en tant qu'auditeur et lecteur; pourtant le but du programme est d'amener l'élève à parler et à écrire. Il s'agissait de vérifier, lors de l'expérience, l'hypothèse selon laquelle il suffirait à l'élève de pouvoir bien comprendre et lire une langue étrangère pour qu'il puisse commencer à la parler et à l'écrire. On n'a fait aucun effort pour corriger les erreurs d'articulation ou d'intonation; on se fiait à la maîtrise croissante de l'élève en tant qu'auditeur pour améliorer sa prononciation.

Autre originalité de ce programme largement autodidacte: après chaque leçon et à la fin du programme entier, l'élève subissait une interrogation du professeur qui devait évaluer non simplement un échantillon, mais le répertoire complet des acquisitions de l'élève au moment donné.

Huit volontaires, jeunes étudiants de 17 à 19 ans, ont suivi le programme qui comportait, selon le cas, 14 à 18 heures de travail. Les résultats ont:
- confirmé l'hypothèse de départ,
- montré l'insuffisance du programme comme *seul* instrument d'enseignement,
- suggéré des directions d'étude et d'application.

Hier wird eine teilweise automatische Methode beschrieben, mit der den Schülern in kurzer Zeit die Grundbegriffe grammatischer Struktur des Deutschen beigebracht werden. Diese Methode ist hergeleitet von einer Analyse sprachlichen Verhaltens gemäß der Theorie des operativen Konditionierens und enthält vor allem die Paarung von Beispielen mit Mustern (*matching to sample*). Das Programm benutzt eine Lernmaschine, welche graphische, auditive oder textliche Stimuli bringt, einfach oder gemischt, und den Schüler zwingt, zwischen mehre-

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[1]) This research was carried out under Contract No. DA–49–193–MD–2577 with the Office of the Surgeon General and Grant No. 5–K3–MH–5744 of the National Institute of Mental Health.

[2]) We are indebted to Father E. P. Dineen, Head of the German Dept. at Georgetown University, for making the experimental test possible.

[3]) A first version of the German program was written by Irene Jones under the supervision of C. B. Ferster. M. I. Rocha e Silva was responsible for a radical revision, extension of the content and scope of the program, and the empirical trial at Georgetown University. C. B. Ferster was responsible for the functional analysis of verbal behavior and its extension to the program construction.

ren textlichen oder graphischen Antworten zu wählen. Folgt er diesem Programm, handelt er insofern als Hörer und Leser. Dennoch ist es das Ziel des Programms, den Schüler zum Sprechen und Schreiben zu bringen. Es geht darum, die Hypothese zu beweisen, daß es für den Schüler genüge, eine Fremdsprache gut verstehen und lesen zu können, um imstande zu sein, sie schon einigermaßen zu sprechen und zu schreiben. Man hat sich nicht bemüht, die Artikulations- oder Intonationsfehler zu korrigieren, sondern vertraute auf die wachsende Hörfähigkeit des Schülers, um seine Aussprache zu verbessern.

Eine andere Eigentümlichkeit dieses weitgehend autodidaktischen Programms: nach jeder Lektion und am Ende des Gesamtprogramms unterzog sich der Schüler einer Examinierung durch den Lehrer, der nicht nur eine kurze Probe vornahm, sondern das gesamte Repertoire des vom Schüler zum fraglichen Zeitpunkt erworbenen Wissens kontrollierte.

Acht Freiwillige, Studenten von 17 bis 19 Jahren, haben bei dem Programm mitgearbeitet, welches, je nach dem, 14 bis 18 Stunden Arbeit umfaßte. Das Ergebnis hat:

- die Ausgangshypothese bestätigt,
- die Unzulänglichkeit des Programms als einziges Unterrichtsmittel bewiesen,
- verschiedene Studien- und Anwendungsrichtlinien erbracht.

INTRODUCTION

This paper describes a semi-automatic method of teaching a rapid introduction to the basic structure of German derived from an operant conditioning analysis of verbal behavior. The predominant procedure is matching to sample (Ferster, 1963; Ferster, 1964). The program is presented to the student on 5 x 8, 8-inch cards, the top part of which consists of a picture or a text. The student selects one of four texts or pictures from the lower part of the card. Reinforcement occurs when the student pushes the button under the text or picture which corresponds verbally or thematically to the sample. For example, in the simplest type of card, when the student hears the German "Buch", reinforcement occurs if he pushes the button under the picture of a book rather than the button under the picture of a chair or a boy; or a picture of a book in the center of the card might be the occasion on which he chooses the text "Buch" rather than the text for chair or boy. Sometimes the upper part of the card presents a picture and a text, a picture and an auditory stimulus, or a text and an auditory stimulus. The student hears "Where is the book?" and with the picture of a boy sitting on a chair and a book under the chair he pushes the button for the text "under the chair" rather than for "on the chair."

The matching-to-sample procedure requires the student to perform as a listener and a reader rather than as a speaker and a writer. Yet the goal of the program was to have the student speak and write. We tested the hypothesis that an extensive repertoire as a listener and reader would provide the basic performance from which speaking and writing could emerge. We reasoned that once the

student could respond meaningfully and in fine detail to the spoken and written language, he had an internal model which could serve as the instant and immediate reinforcement for his speaking and writing (Skinner, 1957). The process is substantially the same as that used to teach phonetics (Smalley, 1961) and similar to the way a child initially acquires verbal behavior. He becomes an accomplished listener ("no, yes, breakfast is ready, breakfast is not ready," etc.) long before he is a speaker because his behavior on these occasions is reinforced or not, depending on what he hears.

The student's inaccuracies of articulation or intonation were not corrected at any point in the instructional program. We looked for improvement in pronunciation paced with the student's ability as a listener. The student began with English articulation patterns and we looked for their continuous shaping and redistribution. The more competent a listener the student became, the more he could react to his own behavior differentially in the direction of the standard forms of the second language.

The teaching program was designed primarily as an experiment and was not intended to be responsible for the student's entire language experience. For experimental purposes we restricted the student's experience to the automatic instructional program so that we could evaluate how much of an active repertoire in the language the matching-to-sample procedure, alone, could develop. If we had total responsibility for the student's second language instruction, we could, of course, supplement the teaching machine experience with other methods.

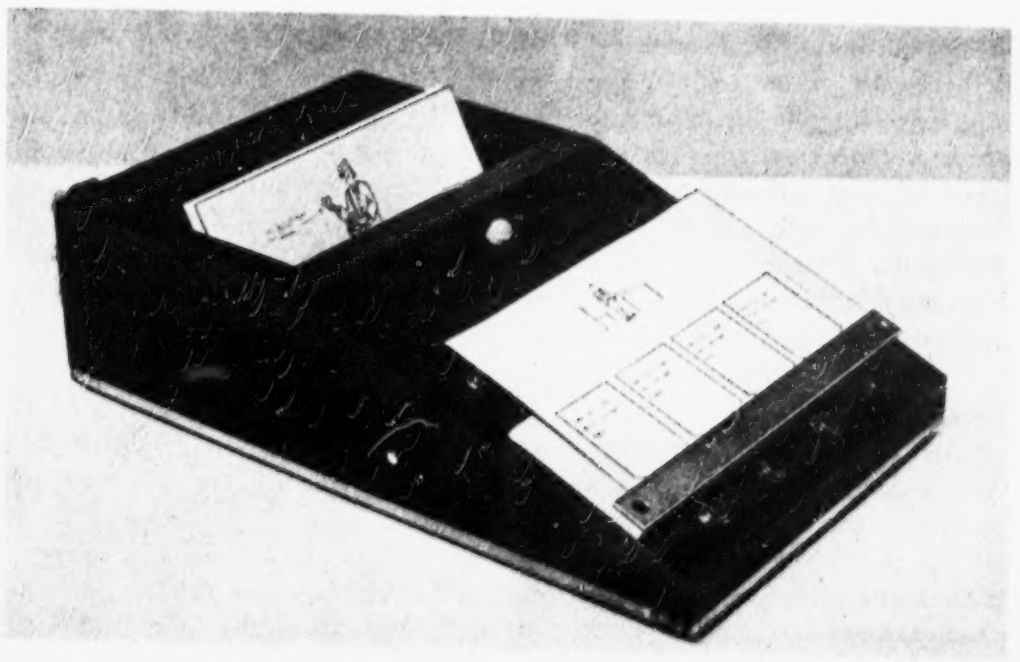

Figure 1. A photograph of the teaching machine used for the matching-to sample procedure.

The program assumed that the student already had a highly-developed verbal repertoire in English, read the Roman alphabet fluently, and had pronunciation patterns at least roughly congruent with those of German. While we expected English structures and usages to interfere with those required in German, we minimized the interference by teaching German without translation. The only time the student heard English was at the start of the course when, for example, he had to be instructed in the use of the teaching machine or the rules for the teacher-student interaction. Most of the instructional procedures could be carried out automatically by relays and other automatic control equipment since the student's point of contact with the program occurred when he pushed a button.

METHOD

The Teaching Machine [4])

Figure 1 is a photograph of the teaching machine into which the student inserts a 5 x 8 card manually. The top part of the card contains the sample stimulus, which in this card is a picture. Below each of the four boxes on the bottom part of the card is a button. (The student is instructed to press the button under the stimulus that corresponds to the picture or text in the center of the card.) The light on the face of the machine (a reinforcement for pressing the correct button) comes on automatically because a piece of conducting foil is pasted behind the card in the position of the correct stimulus. This aluminum foil shorts one of the four pairs of contacts in the machine so that appropriate reinforcement or nonreinforcement occurs, depending on which button the student presses. On cards where the student listens to the spoken language, the right-hand corner of the card is cut away exposing a button underneath, as in Figure 2 D. The tape recorder runs while this button is held down. The student learns to press this until he hears the card number (in the new language) and the stimulus material. Two sharp clicks indicate the end of the stimulus where the student is instructed to release the button before the material for the next stimulus plays.

Sample Frames

Figure 2 shows the kinds of verbal arrangements that were programmed with the cards. In Figure 2 A the stimulus is a picture (or picture and text) and the student chooses one of the four texts below that corresponds thematically with the picture. In Figure 2 B the sample is a text and the student chooses a picture thematically relevant to the text. In Figure 2 C the sample is a text and

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[4]) We are indebted to the Department of Design, Southern Illinois University, and Professor Harold Cohen for their help in redesigning an earlier version of the teaching machine.

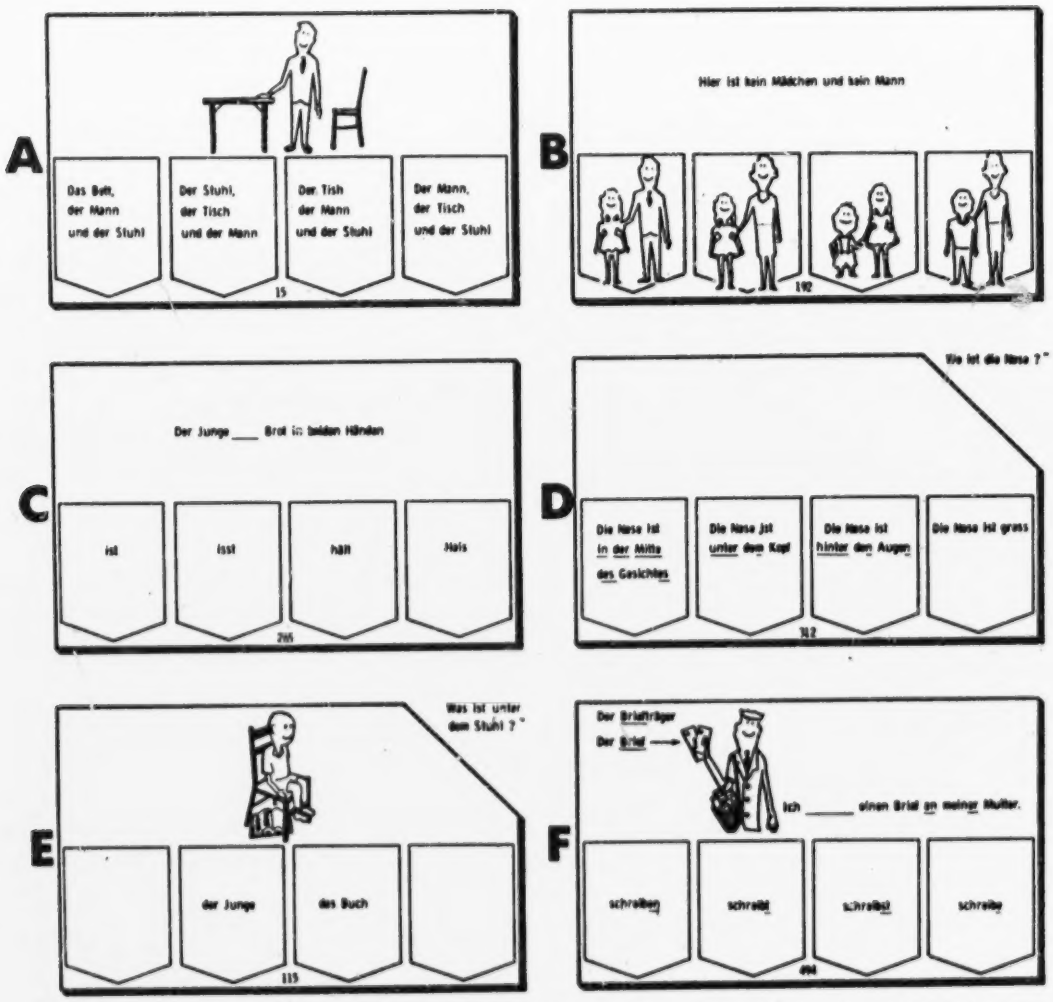


Figure 2. Six sample cards from the teaching program illustrating the verbal arrangements that were used on the cards during the program. The "text", exposed by the cutaway portion of the card, indicates the auditory sample which the student hears when he presses the button. When the card is intact the student responds to the text, picture, or combination of picture and text at the top of the card.

the student chooses the text below that corresponds intraverbally to the sample text. Figure 2 D is an example of a response controlled by an auditory stimulus. Note that the right-hand part of the card is cut away exposing the button underneath; when the student presses the button he hears, "Where is the nose?" Reinforcement occurs if the student chooses the text, "The nose is in the middle of the face." In some cases, the student simply has to pick out a text which corresponds, point-to-point, with the auditory stimulus. For example, he hears, "Monday is the first day of the week" and chooses from the texts, "Monday is the first day of the week", "Monday is the second day of the week" or "Tuesday is the first day of the week." Figure 2 E is an example of a choice based on the

relation between an auditory stimulus and a picture. The student hears "What is under the chair?" and if he is properly controlled by "under" (as opposed to "on") he chooses the book rather than the boy. In Figure 2 F is a card where the verb ending is the critical stimulus.

Subjects

Subjects were 10 volunteer college freshman students, chosen from a group of 29 who responded to a notice through the German department at Georgetown University. Students were accepted for the experiment if they could attend class regularly on Tuesday and Thursday, and if they wanted to learn German because of their interest in a foreign service career with the State Department. Their ages ranged between 17 and 19; they had no previous training in German, and all were in good standing in their university studies.

Probe

Immediately following each lesson that the student completed, there was a brief interaction with the teacher, called a probe. The probe differs from the usual test because it is an attempt at direct measurement of the student's performance rather than a sample of behavior designed to allow us to infer the state of the total repertoire. The probe begins by asking the student to speak in German, as much as he can, along the lines of the material in the preceding lesson. Then the student is shown some of the pictures from the lesson and finally he is prompted either textually or vocally. Thus the probe is designed to exhaust the student's repertoire at all levels from free speech at the start of the probe to a highly determined response at the end, such as "yes" in response to the question "Is that a man?" The probe was carried out entirely in German. Examples of performance in between free speech and a highly determined response such as "yes" or "no" are nonverbal responses such as sitting down in response to a request, or pointing to one of several objects in response to "Which one is a –?"

The answer to the question "How much behavior in the German language does the student have?" needs to be answered by specifying the degree of determination of the student's verbal response by thematic, textual, intraverbal or echoic stimuli. The probe was designed to give us a measurement of the performances generated by the instructional procedure. We could thus have a criterion for whether the student was to go on to the next section, engage in a remedial exercise or repeat the previous section. In most cases the discrepancy between the student's repertoire and our criterion of mastery was sufficiently small so that a few minutes of tutorial during the probe were sufficient to correct any deficiencies. We judged that it was essential that the student achieve perfect mastery of the materials at each stage so that his performance would not be disrupted by a cumulative deficit. The probe also served as a reinforcer for the student's study behavior since it exposed in clear form his accomplishment as a result of the lesson. The probe emphasized the behaviors developed in the

immediately preceding part of the program, so as to give immediate evidence of progress. Thus the probe was a contingency designed to make progress in the new repertoire – a reinforcer.

Though one of the purposes of the probe was to demonstrate to the student, in a form slightly different from the exact form required during the teaching program itself, that his repertoire in German had in fact been substantially augmented, it also provided differential reinforcement in favor of those performances most effective with a fluent listener. The probe also provided direct interpersonal reinforcement for the student's speaking, since the student actually altered the verbal behavior of his teacher in the new language and vice versa. Since the reinforcements during the automatic phase of the program are for reading and listening, the probe was also designed to develop the analogous active behaviors, speaking and writing. By requiring the student to write and speak during the probes, we intended to alter the student's conduct during the automatic phase of the program, in the direction of learning how to convert himself from a listener to a speaker, and from a reader to a writer. For this objective, we could depend upon the transcriptive repertoires already effective in the student's first language where, for example, he could say "chair" after hearing "chair", or write "chair" after reading "chair". To facilitate the development of an active repertoire, the student was told to speak aloud everything he read in German.

The instructor never corrected the student's pronunciation or usage during the probe, since we wished to find out how much active use of the language could be developed by training procedures in which the student is a listener and reader. Students frequently corrected their own errors, however, when the instructor paused after incorrect responses.

Like the intermediate probes the student's achievement at the end of the program was determined by direct measurement of his entire second language repertoire rather than by a test. The student was progressively prompted to get him to engage in all of the German he was capable of under all conditions. The following instructions guided the student during the written part of the final probe.

1. Write a few sentences on any of the themes given during the program.
2. Write some sentences on any other theme you remember.
3. From the list of themes which was given in the program, write a few sentences about those themes about which you have not yet written.
4. Go through the set of pictures which have been used in the frame cards and write sentences about these pictures.
5. Write the story of the Three Little Bears (on the assumption that the student can tell the story in English).
6. Make up a short story.
7. Go through the word list which you have learned in the program and write some sentences with the words which have not yet been used.

There was then some conversation with the student to record his verbal fluency with samples of the same usage. Tape recordings were made for purposes of measuring pronunciation accuracy. The recordings were made both as a student read a text and as he conversed with the experimenter.

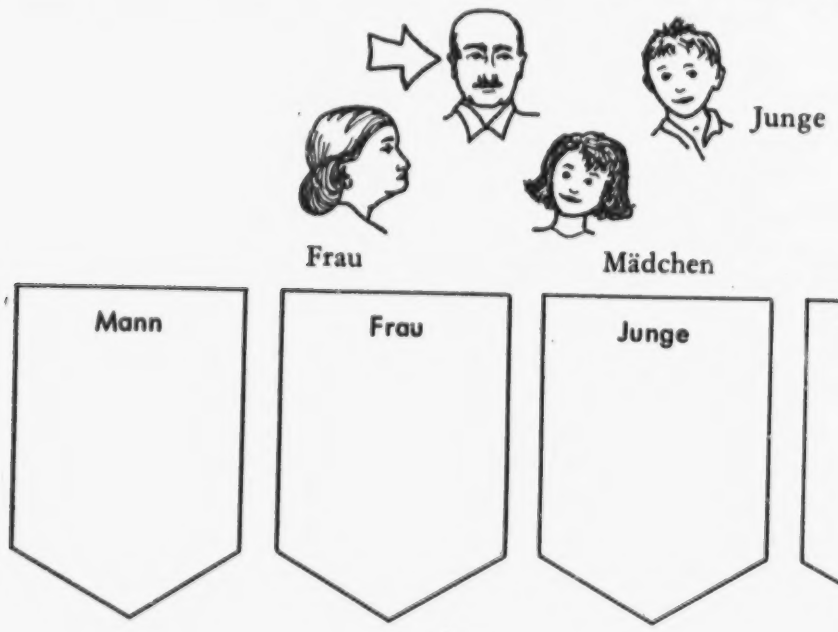
General procedure

In the first session the subject was taught how to use the machine, he was made familiar with the format of the teaching program, and he read aloud from a text (taken from the program) so we would have a record of his reading pronunciation. Sessions were carried out twice a week, each session lasting approximately 3/4 of an hour, depending upon how rapidly the student worked. The first author was present continuously and observed all of the procedures. The probe, the oral interaction with the instructor, took place whenever a student completed a lesson. If a student did not complete a lesson within the allotted time, the probe was postponed to the next meeting after he had completed the unit.

THE DESIGN OF THE PROGRAM

Major programming principle

The major programming principle is that of differentially reinforcing the student's behavior (pushing one of the four buttons under the four choices). By such differential reinforcement, textual and auditory stimuli "in German" control the student's appropriate nonverbal or verbal action as he chooses from the four texts or pictures below. The general principle is to bring the student's



behavior (choosing a text or picture) under the control of progressively finer details of German texts and utterances. In general we begin with a strongly determined response, and then withdraw, one at a time, the sources of control of the behavior, until the student can react to the language in a full natural context. For example, in the very first card, a picture of a boy, girl and woman are labeled appropriately in German, but the man is indicated only by an arrow. The four stimuli below are the four texts corresponding to the pictures. The student picks *Mann* because the other texts can be matched with the appropriate pictures. The card was designed to get the student to read the three texts in respect to the pictures until the response to *Mann* is strong in relation to the choice of the other three texts. On later cards, fewer variables determine the student's response to these texts. For example, in the second card the pictures are no longer labeled, so that the correct choice can no longer be made by matching the choices to the labeled pictures to find the text for the unlabeled figure. Later in the program, there is a larger inclination to pick incorrect choices when, for example, *Junge* (boy) is contrasted in the same card with *jung* (young), and *Frau* (woman) with *Fräulein* (young lady). The multiple-choice format allows us to use natural speech forms and long utterances even though the student is not proficient in all the details of the stimulus at this phase of the course. The amount of detail of the verbal stimulus to which the student needs to attend is determined by how we arrange the contrasts between correct and incorrect choices. In the presence of the text "Wer ist auf dem Stuhl ?" and a picture of two chairs, one with a boy on it, the other with a book on it, the student's choice between *das Buch* (the book) or *der Junge* (boy) depends on whether the stimulus *wer* (who) controls the appropriate behavior in contrast with *was* (what). The control of the student's behavior could be shifted to *auf* (on) if the pictures contained chairs with the same objects underneath as above. Progressively, the student is brought under the control of one part of the sentence at a time. It is not until a much later part of the program that the student is required to distinguish between forms of the article in order to make a correct response. At the early stage of the program, the article *der* is not critical since the student is not confronted with a situation where he has to choose between *die* and *der*. Later in the program, of course, his reinforcement depends on such a contrast.

The program underwent successive empirical tests, with one or two subjects at a time, and was revised each time until the error rate fell to about 3 %. The revisions generally involved making it easier for the student to choose the correct alternatives among incorrect alternatives which are already well established in the student's repertoire and which control responses incompatible with the correct choice. For example, consider an auditory stimulus, "Where is the book?" in conjunction with a picture of a chair on which a boy is sitting and under which is a book. The choice of "on the chair" versus "under the chair" is not very strongly determined as compared with another card in which the auditory

stimulus is "Who is on the chair?". In a next card the choice of "boy" versus "book" is controlled by two stimuli, "who" and "on", either of which, in contrast with "what" and "under", can control a correct choice. This type of card has been illustrated in figure 2F. One type of card teaches the student to listen to an auditory stimulus simply by choosing one of four texts which corresponds, point by point, to what the student hears. Depending on how close the "wrong" texts are to the correct one, the student comes under closer control of the auditory stimulus. For example, the student might hear *vier* (pronounced approximately like the English "fear") and selects the text *vier* from *Tür*. In this case both the initial f and the Umlaut sound can control the student's response. The student becomes a more careful listener, however, when he must choose between the texts *vier* and *für*.

The construction of concepts

Concepts and general classes of usage are developed inductively. First we make sure all of the performances, other than the concept, are firmly in the student's repertoire. To bring the student's behavior appropriately under the control of "on, over, under, next to, in front of, behind", we begin with a reliable repertoire controlled by the text picture and auditory "book, boy, girl, man, chair, table", etc. A series of pictures defines the spatial relations among the objects (The book is next to the chair, the boy is on it, and the chair is next to the table. A cup is on the table and a dog is under the table). A series of cards then requires the student to choose a text thematically appropriate to the picture. The student reads "What is on the table?" and he chooses from "dog", "book" and "cup". He reads "What is under the table?" and chooses from the same texts. The meaning of the preposition comes from the circumstances under which it is reinforced. A series of questions of the form "Where is the bird?", "Where is the boy?", "Who is on the chair?", "What is next to the chair?" amplifies the control of the student's behavior by these prepositions (amplifies the meaning).

Grammatical usage, such as the use of the dative or the accusative following identical prepositions (*auf, neben, unter, in*) is developed in the same way. The concept is developed inductively by differentially reinforcing the student's response, depending upon whether the context of the sentence is transitive or intransitive. Here again the student is at the start capable of all the distinctions required of him except the ending of the definite article. All that is required is that he distinguish between the case of the article depending on the context of the sentence. In actual practice, the student is given a large number of sentences such as "Der Junge ist in . . . Zimmer" or "Der Junge geht in . . . Zimmer." When the usage is intransitive the dative form of the article, *dem*, is reinforced; when it is transitive the accusative form, *das*, is reinforced. As before, the meaning or the concept comes from the differential reinforcement contingencies. The student comes to behave in terms of the rule whether or not he can state it formally. The student's repertoire is developed by

the grammatical rule that "the accusative case is used with transitive verbs and the dative case with intransitive verbs." Although it might be useful to the student to pronounce the rule after he can perform appropriately to it, he can still use the cases meaningfully and accurately, even without being able to state the principle.

The same kind of inductive development of classes of verbal control is carried out with texts without using pictures. For example, the text at the top of the card might be "Are the dishes on the table?", "Are the dishes under the table?" or "Are the dishes over the table?" The student chooses from "on the table", "under the table" or "over the table." In developing control by "who" and "what", the text at the top of the card is "Tom is in the house. Fred is in the forest. There is a small plant in the house but large plants in the forest." Successive cards would then have the questions (1) Who is in the house? (2) Who is in the forest? (3) What is in the forest? (4) What is in the house? In each of the four cards, the student chooses between Tom, Fred, a small plant, a large plant.

Pronunciation

Because we wanted to test the hypothesis that we could achieve progress in pronunciation primarily by training the student as a listener we avoided direct reinforcement and punishment of the student's speech. We presumed that the student will differentially reinforce and shape his own behavior almost automatically as he hears differences between his own speech and the speech of the native speaker, so long as he is an effective listener who can react to nuances of the native speaker's speech. Theoretically, the process we are trying to simulate is the same as that in which a pre-verbal child copies the articulation and intonational patterns of those he admires.

Once the student can react meaningfully to the details of the utterances of the native speaker, he has, in a sense, an "internal model" of parts of his language. Since he is his own listener as well as a speaker, the perception of the speech sounds of others already in his repertoire because of his past experience can serve as a differential reinforcer for successively approximating his own ability to speak. The most effective reinforcers would be those which differentially reinforce and successively approximate the tongue, larynx, and mouth patterns necessary for communicable speech. Even though the ultimate reinforcer that will maintain the student's speech is the change it produces on the behavior of a listener, it is only the instant and immediate consequences of speaking which are a precise enough contingency to reinforce differentially the subtle nuances of articulation, rhythm, and intonation. The effectiveness of the program, therefore, depends upon whether the student talks enough to himself, aloud, so as to provide enough occasions for differentially reinforcing his speech.

Use of textual stimuli

The over-all rate of speech and the length of an utterance were kept as slow and short as possible, consonant with normal rhythm and intonation. As the student came under better control of the language he heard faster speech and longer utterances. We used many texts early in the program, despite the likelihood that the student's pronunciation would be controlled more by his native language than by the new one. The text has the advantage that the student can quickly, easily and repeatedly produce the corresponding auditory stimulus. If a response is weak, repeated exposure to the stimulus may lead to the appropriate behavior when one instance would not. The auditory stimulus, in contrast to a text, is transient. Second, the student will sooner or later have to speak with the articulation and intonation of the second language while he reads from textual stimuli of the same orthography that controlled his behavior in the first language. Eventually the texts control different pronunciation patterns, depending upon the language, because of the differential reinforcement. German patterns in the presence of English and English patterns in the presence of German are extinguished. For example, the English speaker will initially say [dai] for the German definite feminine article *die* and [din] for the German *dein*. But as his listening proficiency develops, the student's own reaction to his speech provides a differential result which will weaken the one response and strengthen the other. Such discriminations probably need to be formed whenever the student will be exposed to texts; in any case, they need to be made eventually, as Sapon's experiments have shown (Sapon, 1963).

Use of behavior already in the student's repertoire

The design of the program depended critically on the student's first language. For example, English usage provides many sources of strength for speaking, reading and listening in German. As a result the program would be different for students with different native languages. First, there are the cognate forms like *Mann* and "man", *Wasser* and "water", *ist* and "is", *habe* and "have", *Haar* and "hair". The supplementary control from cognates in English and German becomes stronger when the student acquires a sufficient number of usages in which the letters *ss* in German control the same behavior as the "t" in English, as in *Wasser* and "water", *Strasse* and "street". Other common elements between the two languages occur in word order and parallel form, for example, "The man is small" and "Der Mann ist klein". In both English and German "the" serves as an autoclitic (Skinner, 1957): a particular man is the subject of the discussion, rather than one of a general class. In other instances, however, German and Spanish are more congruent than English and German. In utterances like "Die Hand des Mannes ist klein" as compared with the Spanish "La mano del hombre es pequeña", German and Spanish are more parallel than German and English. Where the texts control very different behaviors in the student's first and second languages, differential reinforcement eventually re-

duces the induction between the two repertoires. Where the first and second languages have common elements, the texts in the second language continue to be supported by the first language repertoire.

Thematic control

The student's highly developed verbal repertoire in the native language is an important factor in the teaching program. Some of the common repertoire comes from the student's interaction with the physical environment. For example, the moon shines at night, and the sun rises in the morning; dogs, sheep, and cows are animals, but rocks, trees, and water are not; birds, insects and pebbles are small, whereas elephants, mountains and trees are large; the same word is used for "two" in "two animals" as in "two trees". As a result of the student's first language repertoire, many kinds of verbal development need not be repeated in the second language. Once the student identifies birds as small and elephants as large, he can call ants small and cars large without additional experience.

Pictures provide a frequent source for achieving a thematic effect on the listener. If the student is verbally fluent in a first language, a picture will strengthen a whole class of verbal behavior thematically relevant to the picture. When the student behaves verbally in the second language on the occasion of this picture, the same thematic effect on himself as in the first language will serve as a reinforcer. Moreover the reinforcement will be differentially effective in favor of those responses and intraverbal connections which have the same thematic effect as the picture did in the first language.

Initially, the program draws upon behaviors which can be evoked directly by pictures, such as a man, a boy, a table, or a person eating. Many verbal practices, however, do not fit this paradigm, and the latter stages of the program use thematic sources of strength from the student's native language as a method of transferring a verbal practice from English to German. For example, constructions such as "once upon a time", "yesterday", "however", and "if" have no pictorial counterpart. We teach these kinds of verbal usage by thematic control from the context in which they are used, much as a child comes to be controlled by the word "frigate" because the word appears in the context of sails, sailors, ocean, etc. Contexts in which the student encounters the new words teach their "meaning" because the behavior controlled by these words is reinforced or extinguished depending on its compatibility with the normal thematic and grammatical control by the rest of the sentence. If, for example, the word "frigate" happened to strengthen verbal responses other than those thematically related to ships, those responses would go unreinforced and hence be weakened. If "frigate" controlled verbal responses thematically related to ships, those responses would be strengthened. The development of complex language in German is simpler if the student already has these forms in his native language. For example, if the student already knows the story of *The Three*

Bears in English, then the words "once upon a time", "a long time ago", "many years ago", "in ages past", etc. will derive strength from the comparable context of the story in the native language. Futhermore, related variations of this expression will supplement each other because of their common elements, all of which are related to time in the student's existing repertoire. For example, the phrase "once upon a time" will influence the student appropriately partly by its position at the beginning of the story, because of the student's experience with this phrase in the first language.

Theoretically we expected that the student's behavior in German would be reinforced by the thematic effect on himself as a listener that comes from his experience with *The Three Bears* in English. The general plan, therefore, in this technique of programming is to determine some behavior in the student thematically so that the reinforcement for the second language is "to have the same effect on himself." The following paragraph is an example of thematic programming. This text occurs in section 13 of the program (The student has been taught all of the usages except those in italics). The thematic effect of the story serves as a reinforcer developing the new verbal control.

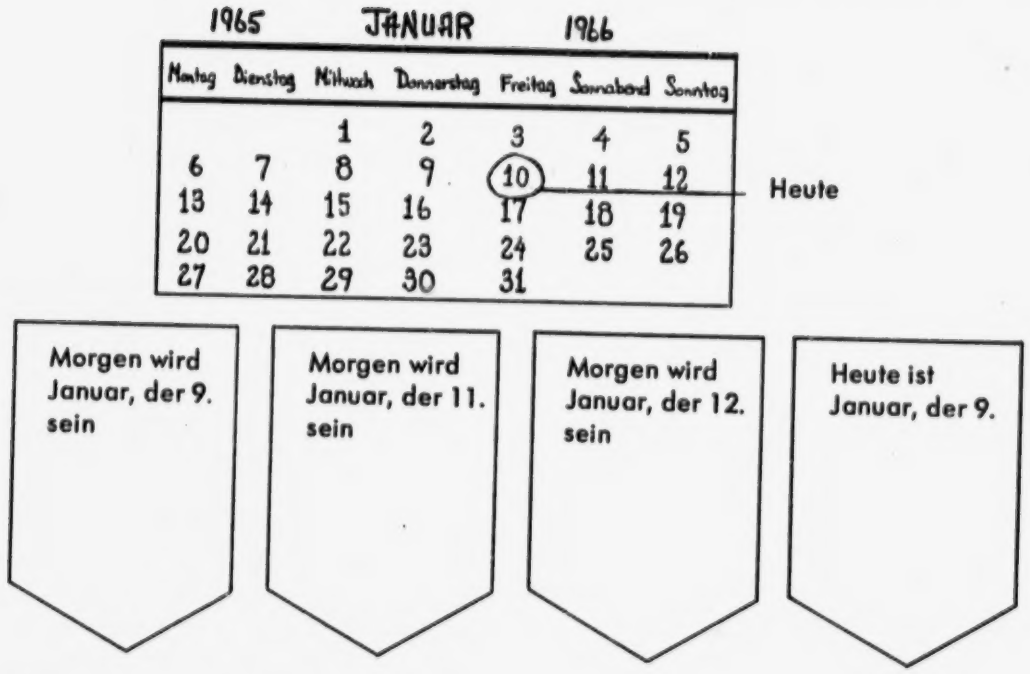
In einem großen Garten ist ein kleines Mädchen. Sie heißt Helene Bülow. Helene hat einen Bruder. Er heißt Wolfgang. Er ist auch in dem Garten. Helene geht um den Garten herum und sieht Wolfgang.

– „Hallo Wolfgang. Guten Morgen."

– „Wo gehst du hin, Helene?"

– „Ich bringe der Mutter diese Blumen. Es sind sechs *rote Rosen.* Siehst du, Wolfgang, wie *grün* die Blätter sind? Das Gras und die großen Bäume sind auch *grün.* Aber die Rosen sind *rot* wie die Lippen. Dieser kleine Busch ist auch *grün.* Aber die Rosen, die ich der Mutter bringe, sind nicht *grün.* Die *Farbe* der *Rosen* ist *rot,* die *Farbe* der Blätter ist *grün* und die *Farbe* der Sonne ist *gelb.*

Most of the control by "Rosen" comes from its formal correspondence with the English word "rose" but the usages for colors come from thematic effects. Other examples of thematic programming occurred in teaching usage appropriate to time and the calendar. Without familiarity with this usage in the first language it would take considerable verbal development to build such a repertoire since we would not be able to borrow supplementary sources of strength from the first language or use the thematic effect as a reinforcer. Since the student already had much behavior in English under the contro! of a calendar, cards such as the following could establish control in German by the stimuli "tomorrow" and "today".


1965 JANUAR 1966
Montag Dienstag Mittwoch Donnerstag Freitag Samstag Sonntag
1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31
Heute
Morgen wird Januar, der 9. sein
Morgen wird Januar, der 11. sein
Morgen wird Januar, der 12. sein
Heute ist Januar, der 9.

The same result could have been accomplished, using only texts, if the student were already under the appropriate control of the verb tenses, as in the following examples.

Stimulus	*Response Alternatives*
_____ I went to the store.	Yesterday, Tomorrow
_____ I will see him.	Yesterday, Tomorrow
Yesterday I ____ him.	saw, see

English provides important sources of strength for German, particularly in usages such as in the following sentences.

If the substance is made out of metal, it will attract a magnet.
To succeed, work hard.
All men are mortal, *some* men are spiritual.
When you are in Florence, you should see the museum.

The major stimulus in the first sentence is "it (a substance) will attract a magnet." The phrase "If the substance is made out of metal" instructs the listener when it is appropriate to say that a substance will attract a magnet. Such a usage has been called an autoclitic by Skinner (1957) and the general control by *if*... *then*... is an autoclitic frame. We assumed that we did not have to teach many of these kinds of usages since German and English have very parallel forms. However, were they not parallel and at those points where the student does not have the needed repertoires, the general techniques of the teaching program

could be easily extended to teaching these. In that event, the program could teach young students who have yet to learn a first language.

Review

Review of previously learned material is carefully built into the program but never accomplished by repetition. Practice of already acquired materials is carried out by requiring the earlier usage in an expanded context. For example, thematic usage developed in one section will be reviewed in the next, which teaches the proper use of the definite article. Review is also carried out by programming progressively finer contrasts between the response alternatives. The same picture or text may control the same choice but the alternatives give a greater chance of confusion because the incorrect alternatives have more plausibility. One way to review old usage in a new context is to increase the length of an auditory stimulus. For example, a student who can choose a picture of a boy when he hears or reads *Junge* will be less able to do so in the context, "Is the boy or girl sitting on the chair?" The choice of a response will be even less sure when the response alternatives as well as neighboring cards make it possible for the boy to be on the table as well as the chair, depending on the picture. Such expanded contexts provided much of the basis for the review. Contrasts between usages are carefully programmed, beginning with the choice of alternate stimuli which control behavior strongly incompatible with the correct choice. Once the student's behavior is reliably controlled by one level of contrast, the contrasts are made finer, paced with the student's ability to sustain the distinction. Thus the stimulus and the reinforced response remain the same with only the unreinforced alternatives varying. Thus the review is accomplished as the student deals with the old usage in new contexts. The procedure is very similar to that used by Smalley (1961).

RESULTS

Error rate during the program.

Of the ten students who elected to take the program, two could not continue because of schedule conflicts with their regular academic program. Seven out of the remaining eight students finished the program. None of the students needed to repeat any part of the program. The average number of errors during the program varied between 2% and 3%. Errors were concentrated mainly in sections 3 and 4. Students M, B, C, and E went through the program with an average error rate of 2%. Students D, W, and McL's average error rate was 3%.

Performance on the written intermediate probes (following six lessons)

The students' mistakes will be reported in the following categories:

Sentence structure

a. Completely wrong form.
   For example: Die Tür und die Vorderseite ist des Hauses.
b. One or two word order reversals.
   For example: Jede Mutter hat mit einem Mann Kinder;
   nicht wohnt; auch frißt.

Word form

c. Wrong form of nouns and modifiers.
   For example: mit *die* Biene ... und *die* Füße .... In dem große ... Hause.
   Die Schaf. *Der* Auge. Der Sohn hat ein ... Hund.
d. Wrong verb form.
   For example: Das Mädchen und der Junge tr*inkt*.
e. Various.
   For example: nicht instead of nein; au*f* dem Glas, instead of aus dem Glas.

Spelling

f. Letter reversal.
   For example: nien instead of nein; wonht instead of wohnt.
g. Letter omission.
   For example: Stü...le; Tis...he.
h. Various.
   For example: Inse*c*kten instead of Insekten; P*b*lanze instead of Pflanze;
   Ameis*l*e instead of Ameise.

Table 1 gives each of the student's errors in the probe as a percentage of the total number of responses. The results are separated by category of error. The letters in the table refer to the categories described in the text. The probes consisted of sentences written by the student in answer to questions given on the tape recorder about a text heard and read by the student prior to the probe. The results of the oral part of the probe will be treated separately.

The following are examples of some of the behaviors required in the probes and the possible kinds of errors. In the section 4 probe the student wrote with the *indirect* object, in answer to the question *wo*. A response required of the student might be as follows:

Der Baum ist neben dem großen Haus und der Vogel ist auf dem Haus.

In the section 6 probe most of the sentences also involved the indirect object. Two sentences with the possessive were also included. One of these latter sentences was:

Die Tür ist an der Vorderseite des Hauses.

In the section 7 probe the direct object was added. For example:

Die Katze hat einen langen Schwanz.

Table 1

Errors on intermediate written Probes are given as Percent of the total Usage. The Subcategories of Errors are Indicated in the Text.

	STUDENTS	M	B	C	D	E	W	Mc L
SECTION 4 PROBE AFTER 270 FRAMES 15 SENTENCES	SENTENCE STRUCTURE			10% IN A 5% IN B				10% IN B
	WORD FORM	1% IN C 1% IN E	10% IN C	1% IN D	20% IN C 1% IN E		25% IN C	
	SPELLING		1% IN H	1% IN G	3% IN F	10% IN F 4% IN G	2% IN F 2% IN G	10% IN F,G 1% IN H
SECTION 6 PROBE AFTER 355 FRAMES 17 SENTENCES	SENTENCE STRUCTURE					1% IN B		
	WORD FORM	1% IN C 1% IN E	1% IN D	10% IN D 1% IN E	10% IN C	1% IN E	12% IN C	10% IN C
	SPELLING	5% IN F 1% IN H	1% IN H	3% IN H	5% IN H	1% IN H		3% IN F 5% IN H
SECTION 7 PROBE AFTER 395 FRAMES 10 SENTENCES	SENTENCE STRUCTURE	1% IN B		10% IN A				
	WORD FORM	1% IN D	5% IN C	10% IN D	15% IN C	10% IN C	10% IN C	10% IN C
	SPELLING			1% IN H	1% IN F		1% IN H	1% IN H
SECTION 9 PROBE AFTER 484 FRAMES *	SENTENCE STRUCTURE				15% IN B			10% IN B
	WORD FORM	20% IN C	10% IN C 1% IN E	10% IN C	20% IN C	5% IN C 1% IN D	10% IN C 1% IN D	10% IN C 10% IN D
	SPELLING			2% IN H	5% IN H		1% IN G	1% IN H
SECTION 12 PROBE AFTER 662 FRAMES 23 SENTENCES	SENTENCE STRUCTURE	1% IN B						1% IN B
	WORD FORM	2% IN C	5% IN C 1% IN D	2% IN C	10% IN C 1% IN E	5% IN C		5% IN C
	SPELLING	1% IN G	2% IN H	10% IN H	1% IN H	2% IN H		5% IN H
SECTION 14 PROBE AFTER 820 FRAMES 21 SENTENCES	SENTENCE STRUCTURE							
	WORD FORM	1% IN C	1% IN E	1% IN D 1% IN E	5% IN C 1% IN E	1% IN C	1% IN C 10% IN D	5% IN C 1% IN D
	SPELLING	1% IN H	1% IN G	2% IN H	4% IN H	2% IN G	1% IN H	1% IN H

* IN THIS PROBE THE STUDENT WAS GIVEN A WRITTEN LIST OF 23 WORDS FROM WHICH HE COMPOSED SENTENCES. THE NUMBER OF SENTENCES VARIED FROM STUDENT TO STUDENT AND THE PERCENTAGE WAS CALCULATED FROM THE NUMBER OF SENTENCES WRITTEN BY THE PARTICULAR STUDENT.

In the section 9 probe the students composed sentences. Twenty-three words were chosen from the preceding section in the program and the student was asked to compose sentences with these words.

In the section 12 and 14 probes all the usages developed in the program were involved. The questions required more complex answers. For example:

Eine kleine Familie wohnt in einem großen Haus in der Nähe des Waldes. Der Sohn hat einen kleinen Hund und die Tochter hat eine kleine Katze.

Even though the student did not have to write or speak to a listener during the automatic part of the program, the performances during the intermediate written probes showed considerable ability to write and speak appropriate to the material of each lesson. Sentences which were not understandable to the instructor were an exception. The percentage of errors in declined forms was relatively low and tended to decrease as the students advanced in the program. The errors in spelling were also relatively few and tended to decrease.

Pronunciation development

Students began to correct pronunciation errors spontaneously as early as section 2 (students M, B, E, and McL.) or section 3 (students D, C, W). Student W's self-correction occurred less frequently but became more regular after section 5. A student's first attempt at self-correction was not always successful. Up to section 8, students M, B, and E corrected difficult pronunciation patterns more successfully when they heard the correct form. After section 8, however, these students were able to pronounce difficult sounds correctly even in the absence of auditory stimuli. For students W. and McL., correct pronunciation in the absence of auditory stimuli occurred only after section 10.

As a general rule, the level of accuracy in pronunciation was lower at the beginning and higher at the end of the section. For students M, B, and E this level rose progressively after section 5. For the other students, the progress up to section 10 was slower.

Student M. (training in French and Latin) reversed the *ie* and *ei* sounds. He overcame this difficulty by section 5. Although he had difficulties with the Umlaut *ö, ü* and *ä*, the *ch* (*Buch*), the initial *z* or *zw* sounds (*Zunge, zwei*), he progressed fairly rapidly toward a creditable pronunciation of these sounds.

Student B. (quite fluent in French – some training in Latin) reversed the *ie* and *ei* sounds. This problem was solved by section 3. His main difficulties were: the Umlaut *ö* and *ü*, the *ch* sound and the initial *z* and *zw* sounds. His progress in these sounds was very slow until section 5. He had a tendency to stress the final syllables (as in French).

Student E. (training in French and Latin) reversed the *ie* and *ei* sounds. This problem was solved by section 2. He had some difficulties with *ch*, initial *z* and *zw* sounds. His progress in these sounds was fairly rapid. He had no trouble with the Umlaut and his general initial level in accuracy was the best.

Students C, D, W, and McL. had problems with all the new sounds in varying degrees.

Student C. (a small amount of training in French) reversed *ie* and *ei* sounds until section 3. He had difficulties with all the other German sounds. From section 4 onward, he repeated difficult sounds (such as *ö, ü, ä, ch,* and sounds of *r,* initial *z* and *zw,* etc.) to himself. In his self-corrections he improved first in the Umlaut, and next in the *ch.* By section 10 he was showing a general improvement.

Student D. (training in French) had no problems with *ie* and *ei* sounds. He had the same general difficulties as Student C. His pronunciation of the Umlaut began improving at section 6 but his progress was slower than that of Student C.

Student W. (training in French and Latin). He reversed *ie* and *ei* sounds up until section 8. From section 3 onward the frequency of reversal became lower as his self-correction in these phonemes became more frequent. But he very often relapsed into incorrect pronunciation until section 8. The difficulties with the Umlaut *ü* and with the *ch* sound followed the same pattern as those of *ie* and *ei* reversals. Though there was gradual improvement, he frequently reverted to less accurate pronunciation of the *ü* and the *ch* even after section 10.

Student Mc. L. (5 years of Spanish in high school). This student had far more pronunciation difficulties than all the others. Even his first reading test was far from the rough initial approximations of the other students. By section 2 he began to correct himself but even the corrections were not successful. He also failed in his attempts to correct the *ch* (as in *Buch*) and initial *z, zw* even though the frequency of his repetitions was much higher than that of the other students. By section 5, however, he pronounced most of the Umlaut sounds in a very acceptable form except in *Bücher,* where the difficulties with the combination of the two difficult sounds in one word disrupted the performance. By section 9 and 10 his pronunciation of even the most difficult sounds had greatly improved. Considering his initial difficulties, this student's progress was the more dramatic.

While the students' pronunciation showed English influences even after the program, we judged their progress toward correct patterns to be at least equal to that of most students after a semester of study in a conventional college course.

Rate of work

Table 2 shows the amount of time each of the seven students spent on the teaching program.

Table 2

Amount of work in hours and minutes

Students	on the program	on the written intermediate probes	with the monitor*	Total
E	8.17	1.50	4.15	14.22
M	7.10	2.05	5.10	14.25
D	8.02	2.10	4.40	14.52
B	8.59	1.50	4.35	15.44
C	7.45	1.55	5.15	14.55
McL.	9.27	1.55	5.40	17.02
W	9.55	2.30	6.20	18.45

*Oral probes and correction of the written probes

The total time to complete the program ranged from 14 to 18 hours with about half of the time spent on the written probes and in oral interaction with the monitor. The time spent on each card ranged between 20 to 30 seconds.

The Final Probe

The students wrote from 5 to 15 sentences in each of the seven parts of the probe. Each student wrote between 60 and 90 sentences in all.

Students M, B, C, D, and E wrote sentences using most of the declined forms taught in the program and composed new sentences which had not been used in the program. The two students whose error level was highest, McL. and W, composed sentences which were closer to the structures and word forms taught in the course.

In the following data, the students' errors are reported as errors in sentence structure, word form and spelling. A few sentences taken from each student's probe are also given to illustrate the general form of their compositions, which were written without any thematic or textual support. The letters refer to the details of structure form and spelling described on page 101.

Student M wrote a total of 98 sentences.

Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
0	4	19	0	4	1	2	3

Ein Haus ist in der Mitte des Gartens und in der Nähe des Waldes. In diesem Haus wohnt eine Familie mit vier Personen, ein Vater, eine Mutter, ein Sohn und eine Tochter. Der Sohn geht in den Wald. In dem Wald wohnen die Tiere und die Pflanzen.

Student B wrote a total of 91 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
0	5	23	5	0	1	7	3

Er wohnt in "Mars" aber er hat zwei Ohren an beiden Seiten des Gesichtes. Das Haar der Frau ist lang aber das Haar der Männer ist kurz. Diese Blätter sind grün: der Baum hat kein Wasser. Das Gras um den Baum herum ist nicht grün.

Student C wrote a total of 76 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
0	0	21	2	1	2	2	7

Die Sonne geht auf. Es ist früh. Ich liege in meinem Bett; ich schlafe nicht. Ich bin wach. Ich gehe in das Eßzimmer. Mein Vater, meine Mutter und ich essen Brot mit Honig oder Butter. Wir trinken Kaffee mit Milch oder Zucker.

Student D wrote a total of 65 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
2	0	11	0	0	0	3	9

Ich bin ein Student in der Georgetown Universität. Ich studiere Deutsch. Ich bin achtzehn Jahre alt. Meine Brüder sind Tim, Pat und Mike. Ich habe keine Schwestern. Pat und Mike sind Zwillinge. Sie sind zehn Jahre alt.

Student E wrote a total of 63 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
0	2	22	1	0	2	5	0

Auf dem ersten Bild ist ein Stuhl vor dem Tisch und auf dem Tisch sind ein Glas und ein Teller. Auf dem zweiten Bild ist ein Haus. Ein Baum ist vor dem Haus und ein Vogel ist über dem Haus. Die anderen Karten haben Bäume mit wenigen und vielen Blättern.

Student Mc. L wrote a total of 87 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
3	0	31	1	3	0	5	1

Ein Vater und eine Mutter haben zwei Kinder. Der Mann ist der Vater und die Frau ist die Mutter. Das Mädchen ist die Tochter und der Junge ist der Sohn. Das Mädchen ist elf Jahre alt und der Sohn ist vierzehn Jahre alt. Diese kleine Familie wohnt in einem großen Haus.

Student W wrote a total of 82 sentences.
Errors

sentence structure		word form			spelling		
a	b	c	d	e	f	g	h
0	3	33	2	0	8	7	15

Die Personen trinken Bier aber die Katze trinkt Milch. Eine Person ißt Brot mit Butter und Honig. Die Bären fressen auch Honig. Die Bären leben in dem Wald. Die Bären sind große Tiere. Sie schlafen in dem Gras unter dem Baum.

The following text composed by Student C during the final written probe is an example of the range of structures and usages of which the student is capable at the end of the program.

1. Bitte schreiben Sie *einige* Sätze über ein Thema des Programmes.

Die Sonne geht auf. Es ist früh. Ich liege in meinem Bett; ich schlafe nicht. Ich bin wach. Ich gehe in das Eßzimmer. Mein Vater, meine Mutter und ich essen Brot mit Honig oder Butter. Wir trinken Kaffee mit Milch und Zucker. Mein Bruder und meine Schwester sind nicht in dem Eßzimmer. Sie sind in dem Schlafzimmer; sie schlafen. Die Betten sind in dem Schlafzimmer, und ein Tisch und viele Stühle sind in dem Eßzimmer. Es ist Sonnabend. Ich lerne Deutsch in der Georgetown Universität.

2. Bitte schreiben Sie *einige* Sätze über ein anderes Thema des Programmes.

Helene Bülow ist in einem Garten. Es ist ein kleines Mädchen. Sie hat viele Blumen in den Händen. Der Vater dieses kleines Mädchen ist Herr Bülow und die Mutter ist Frau Bülow. Der Bruder heißt Wolfgang. Wolfgang sieht Helene in dem Garten. „Guten Morgen, Helene. Wie geht es dir?" „Danke, und dir?" „Danke, gut." „Gehen wir in das Haus und trinken wir Kaffee und essen wir Brot mit der Mutter." „Ja, gut."

3. Hier ist die Liste der Themen des Programmes. Bitte schreiben Sie einige Sätze über die anderen Themen.

Das Haus ist in der Nähe des Waldes. Es ist auch in der Mitte des Gartens. Das Haus hat eine Vorderseite und drei Seiten. Eine Tür und ein Fenster sind an der Vorderseite und drei Fenster sind an jeder Seite. Das Haus hat auch ein Dach. Das Dach hat auch ein Fenster. Das Dach hat keine Tür. Eine kleine Familie wohnt in dem Haus. Der Vater und die Mutter sind die Eltern und der Sohn und die Tochter sind die Kinder. Ein Tisch und viele Stühle sind auch in dem Hause. Viele Tiere leben in dem Wald. Pflanzen leben auch in dem Wald. Die Bären und die Bäume sind in dem Wald. Die Blumen sind in dem Garten.

4. Hier sind einige Bilder des Programmes. Bitte schreiben Sie *einige* Sätze über diese Bilder.

Die Kühe und die Katzen trinken Wasser. Das Schaf frißt Gras und das Pferd frißt Blätter. Der Junge ißt Brot mit Honig oder Butter. Die Blume ist offen. Der Junge hat viele Haare. Ein Mann hat keine Haare und der andere hat wenig. Der Elefant hat einen großen Körper und der Vogel hat einen kleinen Körper. Der Junge ißt einen Apfel. Viele Äpfel sind in dem Teller und zwei Äpfel sind auf dem Tisch. Die Schachtel ist offen. Eine Schuh ist neben den Schachteln. Die Tasse ist zwischen den Schachteln. Die große Schlange hat einen langen Schwanz, und die kleine Schlange hat einen kurzen Schwanz. Das Mädchen trinkt Milch.

5. Hier ist die Liste der Wörter des Programmes. Bitte schreiben Sie *einige* Sätze mit diesen Wörtern.

Der Vogel hat zwei Flügel. Der Hund lebt in dem kleinen Haus. Eine Person hat zwei Hände. Die Fliege ist ein Insekt. Der Hals ist zwischen dem Kopf und dem Rumpf. Die Lippen und die Rosen sind rot. Die Sonne ist gelb. Die Zähne sind in dem Mund.

6. Bitte schreiben Sie *einige* Sätze über „Die drei Bären" die in dem Wald wohnen.

Die drei Bären leben in dem Wald. Der Vater und die Mutter und der Sohn fressen Honig. Die Biene macht Honig. Die Bären gehen um den Baum mit dem Honig. Es ist nicht gut. Die Bären haben nicht Honig. Die Bienen haben den Honig. Die Bären schlafen nicht in dem Bett. Sie schlafen in dem Wald. Im Dezember, im Januar und im Februar schlafen sie. „Die Bären sind in diesem Wald." Die Personen gehen nicht in diesen Wald.

The final oral probe

The oral probe consisted of a conversation with the instructor and questions about some of the pictures presented in the program. The following was the conversation with Student E taken from the tape recording. The texts are presented as approximations of their vocal counterparts. How closely the student's pronunciation conforms to standard forms has been discussed already.

Teacher	*Student*
1. Guten Tag.	Guten Tag.
2. Wie geht es Ihnen?	Danke, gut. Und Ihnen Frau Silva?
3. Danke, gut. Wie heißen Sie?	Ich heiße Evans.
4. Wie alt sind Sie?	Ich bin zwanzig Jahre alt.
5. Sind Sie ein Student?	Ja, ich bin ein Student.
6. Wo studieren Sie?	Ich studiere in der Georgetown Universität.
7. Wo wohnen Sie?	Ich wohne in Massachusetts.
8. Wo wohnen Ihre Eltern?	Sie wohnen auch in Massachusetts.
9. Haben Sie viele Brüder?	Nein, ich habe nur zwei Brüder.
10. Haben Sie auch Schwestern?	Ja, ich habe zwei Schwestern.
11. Wie heißen Ihre Schwestern?	Meine Schwestern heißen Ora und Mara.
12. Wie alt sind Ihre Brüder?	Meine Brüder sind ein-und-zwanzig und zehn Jahre alt.
13. Herr Evans, sagen Sie mir, bitte, die Tage der Woche.	Die Tage der Woche sind: Montag, Dienstag, Mittwoch, Donnerstag, Freitag, Sonnabend, Sonntag.
14. Welcher ist der erste Monat des Jahres?	Der erste Monat des Jahres ist Januar.
15. Und der letzte?	Der letzte ist Dezember.
16. Herr Evans, welche sind die Artikel auf Deutsch?	Die Artikel auf Deutsch sind der, die, das, ein, eine.
17. Wie schreibt man die Substantive auf Deutsch?	Mit einem großen Buchstabe.

At this point the student was shown pictures, as indicated, and the student responded to oral questions.

18. Was ist das?	Das ist ein Wald.
19. Was sind diese Tiere?	Diese Tiere sind Bären.
20. Schläft dieses Mädchen oder ist sie wach?	Dieses Mädchen schläft.
21. Und diese Personen?	Diese Personen sind wach. Sie liegen auf dem Boden.
22. Wo ist dieses Buch?	Unter dem Stuhl.
23. Und die Tasse?	Die Tasse ist neben der Flasche.
24. Wo ist dieser Junge?	Dieser Junge ist hinter dem Baum.
25. Und dieser?	Dieser Junge ist vor dem Baum.
26. Wieviele Bücher sind offen?	Ein Buch ist offen.
27. Und wieviele sind geschlossen?	Zwei Bücher sind geschlossen.
28. Ist dieser Mann alt?	Nein, dieser Mann ist jung.
29. Und dieser?	Dieser ist alt.
30. Wie hält diese Frau das Baby?	Sie hält das Baby in beiden Armen.

-. Wer hat lange Haare, der Junge oder das Mädchen?	Das Mädchen hat lange Haare.
32. Wo sind die Ohren?	Die Ohren sind an beiden Seiten des Gesichtes.
33. Wo ist der Ellbogen?	Der Ellbogen ist in der Mitte des Armes.
34. Und die Nase?	Die Nase ist in der Mitte des Gesichtes.
35. Wo sind diese Stühle.	Diese Stühle sind um den Tisch herum.
36. Gut, danke Herr Evans.	Bitte, Frau Silva.
37. Auf Wiedersehen, Herr Evans.	Auf Wiedersehen, Frau Silva.

DISCUSSION

For purposes of our experiment we have restricted the student's experience to the multiple choice procedure and the probes. Nevertheless, the student gained proficiency as a speaker and writer even though his training experiences were, with limited exceptions, restricted to listening and reading. There was a substantial rate of development of ability to pronounce the language, despite the absence of any experiences in which the program provided direct consequences for the student's pronunciation. These results supply confirmation to our hypotheses underlying the basic construction of the program, that training the student as a listener would influence proficiency in speaking. Nevertheless, we do not recommend this program as a sole experience, since other types of procedures are useful for different outcomes. Yet it is clear that it is possible to develop an active use of basic parts of a language with a simple automatic program taken over a short period of time.

After taking the program, the students pronounce German sufficiently well that any German listener would have no difficulty in understanding them; nevertheless, their approximation of correct German pronunciation is still gross, and we do not know how closely an approach as outlined here can approximate the nuances of German pronunciation we refer to as a good accent. It seems reasonable to expect that new conditions of reinforcement are required to produce exact conformation to German pronunciation patterns beyond that which is required simply to have a native listener understand. In any event, it seems reasonable to experiment with procedures that postpone such experiences until the student has mastered many of the other aspects of the use of the language. The critical research that will be needed will be experiments in which the point-to-point change in the students' pronunciation is measured as a function of different levels of proficiency as a listener. The use of the teaching program as a practical classroom device would be limited by the large amount of time needed to administer the probe. Although the probe was not a teaching device in the usual sense, we judged it to be an important factor in the program's effectiveness. Many modifications of the probe procedure used in this experiment

could be proposed as a result of our experiences. Some of the functions of the probe could be carried out in a group in the classroom, where the students in recitation, conversation or oral examinations could demonstrate the newly acquired repertoires. We have begun to experiment with probes which are semi-automatically administered through appropriate texts and tape recordings. These lack, however, a sure criterion to determine objectively whether the student has achieved sufficient mastery to go on to the next lesson. Perhaps a solution might be a combination of automatic probes, classroom procedures and periodic diagnostic tests. Despite the large amount of time spent with the probes, they did not instruct in the usual sense that we speak of teaching. The major event in the probe was that the student was given an opportunity to observe his own achievement. We judge this reinforcer to be an important factor in the effectiveness of the program. Even though the probe did not teach in the usual sense, it provided a reinforcer which determined the form of the student's behavior as he operated the teaching machine.

The program which we have described is only a first approximation and will require significant modification as a result of experiences with the first test and subsequent, more extensive testing. Major problems of redesign should include a more rational basis for the choice of the initial vocabulary, of more natural usage, and of the sequence by which it is included in the program.

The present experiment used English-speaking students, whose basic pronunciation patterns and native-language structure are very similar to those of German. Since one of the properties of the program is the potentiality of transcribing it, almost directly, into many other languages, additional research will be required in studying the problems raised by differences among languages. Many of these problems might be anticipated by linguistic analysis. These problems will be more acute where either the native language or the second language contains pronunciation patterns which are very different from those in the language to be taught.

We are extending the same principles and technique to the problems of dislexia and reading instruction with young children. Just as with second-language instruction, the matching-to-sample and probe procedures are a way to teach reading automatically without direct reinforcement of the student's vocal behavior.

While the experimenters had some training in phonetics and could make at least a rough phonetic analysis of the student's responses, the results were reported only in enough detail to convey gross changes. To measure the effects on pronunciation patterns of training the student as a listener, more careful experiments are needed, such as:

1. Careful measurement of the student's initial pronunciation patterns, as a speaker, a reader, and in free speech.

2. Training of the student as a listener, carried out objectively so that the change in the student's articulation can be related point by point to the changes in the student's perception of the sounds.

3. A phonetic analysis of the changes in the student's pronunciation. We take the results of the present experiment, however, to confirm the importance of the listening function and encourage us in the direction of finer grained experiments. We judge that the reason other investigators (Liberman, 1957; Mace, 1965; Underwood & Schultz, 1960) have not confirmed our hypothesis is that the training of the student as a listener did not use critical contrasts during the discrimination training; as a result the student was not forced to attend to the details of the spoken sounds that form the basis for the fine-grain articulation patterns that are necessary for accurate pronunciation.

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